

### **REMARKS/ARGUMENTS**

In the most recent Office Action, claims 1-19 were examined. Claims 1-15 are allowed. Claims 16-19 stand rejected. Claims 1 and 16 are amended. No new matter is added.

Applicants thank the Examiner for the thorough search and consideration of the present application, and respond to the Examiner's comments as follows.

#### **Premature Final Rejection**

The Office Action states that it is a final action with new grounds of rejection necessitated by applicants' amendment, citing MPEP §706.07(a). The entirety of applicants' amendment is the addition to claim 16 of the phrase:

of a power semiconductor device.

This amendment to claim 16 describes an application of the current sense structure defined in the claim. Applicants note that claim 1 in its original form recites:

a current sensing structure for a power semiconductor device.

Accordingly, the phrase added to claim 16 was already present as subject matter described in other claims that are allowed in the application. Accordingly, the amendment to claim 16 does not raise any new issues that require any further search or new grounds for rejection.

However, the Office Action states that applicants' amendment necessitated the new grounds of rejection. This position is unsupported in the current record of the application and in the subject matter described in the claims. MPEP §706.09(a) states:

a second or any subsequent action on the merits in any application or patent involved in reexamination proceedings should not be made final if it includes a rejection, on prior art not of record, of

any claim amended to include limitations which should reasonably have been expected to be claimed.

Because the amendment to claim 16 recites subject matter that was clearly in the application, and recited in other allowed claims in the application, the final rejection of claims 16-19 is premature, and applicants respectfully request that it be reconsidered and withdrawn. MPEP §706.07(c) and (d).

#### **Claim Rejections - 35 U.S.C. §103(a)**

The Office Action states that claims 16-17 and 19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Needham et al. (U.S. Patent No. 5,570,034). In particular, the Office Action states that Needham et al. disclose a current sense structure with all of the elements recited in claims 16-17 with the exception of a printed circuit board, which is considered to be equivalent to a substrate described by Needham et al. Applicants respectfully traverse the rejection.

Applicants first note that the disclosure by Needham et al. is directed to sensing current in a VLSI substrate with low power CMOS components. It is the particular focus of the device disclosed by Needham et al. to sense the small currents that are present in low power CMOS devices. That is, the device by Needham et al. is designed to work with low power semiconductor devices, such as VLSI circuits.

However, claims 16-17 and 19 describe a current sense structure for a conductor in “a power semiconductor device.” It should be evident that power semiconductor devices are significantly different than low power CMOS devices and are in particular substantially different than low power VLSI circuitry. While low power VLSI circuitry deals with currents on the order microamps, power semiconductor devices like that described in the claims of the present invention handle currents on the orders of hundreds of amps, approximately nine orders of magnitude in difference. Accordingly, the current sensing device described by Needham et al. is highly sensitive to small currents, and would be unusable in a power semiconductor device like that described in the claims of the present invention.

The disclosure by Needham et al. also calls for a current measuring device that incorporates two current sensors or hall effect devices that operate as common mode or differential sensors, depending on the applications. For example, the current sensing structure disclosed in Figure 4 of Needham et al. operates in common mode, where one sensing device senses a desired circuit current in addition to noise currents produced by background interference, while another sensor senses only noise currents produced by background interference. The outputs of the two sensors are combined to cancel the background interference to obtain the desired current sense signal. In the current sense device disclosed in Figure 2 by Needham et al., the current sense devices are operated in differential mode, where both current sensors sense a desired conductor current and current produced by background noise interference. Because the background noise interference affects both current sensors equally, the differential output of the sensors obtains the desired conductor current sense. In each of these two current sense configurations, Needham et al. measure extremely small currents that are highly sensitive to background noise and interference from the earth's magnetic field, thus requiring additional circuitry to increase measurement sensitivity. Accordingly, the arrangements provided by Needham et al. require two separate current sense devices for measuring small currents in a conductor.

The present invention recited in claims 16-17 and 19 calls for a single current sense device without any additional sensing inputs. Accordingly, the present invention recited in claims 16-17 and 19 has a simplified current sense structure than that disclosed by Needham et al. and does not employ the dual sense structure that is required according to the disclosure by Needham et al. to operate the prior art current sense structure.

Applicants note that the omission of an element found in the prior art reference with the retention of the element's function indicates that the invention is non-obvious. MPEP §2144.04(II)(B). Applicants have eliminated a current sensor over the current sense structure disclosed by Needham et al., while retaining the function of current sensing, thereby supporting a conclusion of patentability for the invention recited in claims 16-17 and 19.

Applicants note in addition, that if the prior art current sense structure of Needham et al. were modified in accordance with the invention recited in claims 16-17 and 19, the proposed

modification would render the prior art unsatisfactory for its intended purpose, thereby defeating the support for a case of *prima facie* obviousness. MPEP 2143.03. That is, if the device by Needham et al. were modified to have a single current sensor, it would no longer be capable of operating properly. If the device were modified to be used with a power semiconductor, it would have extraneous parts or an unsuitable range of measurement that would again defeat its purpose.

Applicants further note that while the Office Action states that the substrate disclosed by Needham et al. qualifies as a printed circuit board because it has printed circuit traces on its surface, this statement is wholly lacking in support in the disclosure by Needham et al. That is, the disclosure by Needham et al. is completely void of any mention or discussion of printed circuit traces on a surface of a substrate, contrary to the statement made in the Office Action. Accordingly, the Office Action has failed to provide evidence of obviousness with regard to the printed circuit board element recited in claims 16-17 and 19. With regard to rejections under 35 U.S.C. §103, “the Examiner must provide evidence which as a whole shows that a legal determination sought to be proved (i.e., the reference teachings establish a *prima facie*) is more probable than not.” MPEP §2142. The Office Action provides no citation to evidence tending to support a conclusion of obviousness, but instead states:

however, it appears that the substrate would be qualified as a “printed circuit” because it has printed circuit traces on its surface. Furthermore, the term “printed circuit board” is a broad term, therefore, any substrate with printed electrical traces on it [sic] surface would be equivalent to the printed circuit board.

Needham et al. fail to disclose or even hint at a substrate with printed circuit traces. Apparently, the Examiner seeks to support a *prima facie* case of obviousness with the above statements, which only serves to state the legal conclusion sought to be proved, rather than provide any evidentiary support for a *prima facie* case of obviousness. Because the Examiner has failed to provide evidence of obviousness as required, no *prima facie* case of obviousness has been established.

In view of the above discussion, applicants respectfully submit that the rejection of claims 16-17 and 19 under 35 U.S.C. §103(a) of the disclosure by Needham et al. is overcome, and respectfully requests that it be reconsidered and withdrawn.

Claims 16-19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Erickson (U.S. Patent No. 5,436,557) in view of Needham et al. In particular, the Office Action states that the combination of Erickson and Needham et al. show all of the elements of claims 16-19 in an obvious combination. Applicants respectfully traverse the rejection.

The Office Action states that Erickson discloses a hall magnetic field transducer mounted to a surface of a printed circuit board, as described in claims 16-18. However, a review of the disclosure by Erickson shows that a magnetically sensitive component is disposed on a ceramic chip package that has electrical leads for connection to a printed circuit board. The magnetically sensitive component disclosed by Erickson is not mounted on a surface of the printed circuit board, but rather mounted in a ceramic chip package, which is in turn mounted on the printed circuit board. In accordance with the recitation in claims 16-19, the inventive current sense structure includes:

a magnetic field transducer mounted on the surface of said printed circuit board and adjacent said edge portion.

In the prior art current sensor shown by Erickson, the magnetically sensitive component is suspended above the printed circuit board by the ceramic chip package to take advantage of the magnetically permeable core arrangement that is also suspended above the printed circuit board by a holder. If the magnetically sensitive component were not suspended above the printed circuit board, it would not be aligned with the magnetically permeable core, and fail to accomplish the goal of its intended purpose.

The present invention recited in claims 16-19 calls for a magnetic field transducer to be mounted directly on a surface of a printed circuit board, thereby providing a low profile in a compact package with minimized manufacturing difficulty and expense while obtaining improved current sensing performance. These advantages cannot be realized in the current sense structure disclosed by Erickson. Furthermore, and as noted in the Office Action, the device

disclosed by Erickson is unsuitable for use with a power semiconductor device. Accordingly, the invention recited in claims 16-19 contains elements that are not found in the disclosure by Erickson.

The Office Action further states that while Erickson does not disclose current sensing in a power semiconductor device, the same is taught by the disclosure of Needham et al. in a CMOS circuit. However, as discussed above, the current sensing device disclosed by Needham et al. is for very low power integrated circuits, rather than for power semiconductor devices. The current sensor disclosed by Needham et al. requires special circuitry to obtain a current sense of the small currents provided in the VLSI CMOS circuit without undue noise and interference influencing the measured current. Accordingly, Needham et al. fail to teach measurement of current flowing in a conductor of a power semiconductor device, which current would be many orders of magnitude larger than the current flowing in the conductors described by Needham et al. Thus, even if the disclosures by Erickson and Needham et al. were to be combined, one or the other would have to be significantly modified to extend beyond the reach of its original disclosure and subvert the original purpose for which the device was intended. Indeed, even if these devices disclosed by Erickson and Needham et al. could be combined to produce the invention described in claims 16-19, not only would the combination be missing elements described in claims 16-19, but the resulting device would be unworkable because the device by Needham et al. could not be made to measure the high currents in a power semiconductor device, and removing one of the current sensors in accordance with the disclosure by Erickson would defeat the purpose of sensitive measurements required by the disclosure of Needham et al.

In addition, if the device by Erickson were used with a power semiconductor device, the interference with the power semiconductor device from such an arrangement would be extensive, and again defeat the purpose of the disclosed device. Accordingly, any combination of the disclosures by Erickson and Needham et al. to arrive at the invention recited in claims 16-19 would leave one of ordinary skill in the art at a loss as to how to arrive at the present invention. Applicants therefore respectfully submit that the invention recited in claims 16-19 is patentable over the disclosures by Erickson and Needham et al., either alone or in combination. Applicants

accordingly respectfully request that the rejection of claims 16-19 under 35 U.S.C. §103(a) over Erickson in view of Needham et al. be reconsidered and withdrawn.


### Conclusion

Applicants have amended claims 1 and 16 in keeping with the helpful suggestions provided by the Examiner in the Office Action. In view of these amendments and the above discussion, applicants respectfully submit that the application is now in condition for allowance and earnestly solicit notice to that effect. Applicants further believe that the present response addresses all issues raised in the most Office Action, and that claims 1-19 are patentable over all of the cited prior art references. Applicants respectfully request that any issue remaining with regard to allowance of claims 1-19 be resolved in a telephonic interview with the undersigned counsel at the number provided below.

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Brendan J. Kennedy


Name of applicant, assignee or  
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Signature

October 9, 2003

Date of Signature

Respectfully submitted,

  
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